

## Pesticide Usage Pattern and Farmers Perception in Curry Leaf [*Murraya Koeinigii* (L.) Sprengel]

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**Abstract:** Curry leaf [*Murraya koeinigii* (L.) Sprengel] exported from India had insecticide residues above maximum residue limits, which are hazardous to consumer health and caused rejection of the commodity at point of entry in Europe and middle east resulting in a check on export of curry leaf. Hence to study current pesticide usage patterns in major curry leaf growing areas, a survey on pesticide use pattern was carried out in curry leaf growing areas in Guntur districts of Andhra Pradesh during 2013-14, by interviewing farmers growing curry leaf utilizing a questionnaire to assess their knowledge and practices on crop cultivation, general awareness on pesticide recommendations and use. Education levels of farmers were low, wherein 13.96 per cent were only high school educated and 13.96% were illiterates. 18.60% farmers were found cultivating curry leaf in less than 1 acre of land, 32.56% in 2-5 acres, 20.93% in 5-10 acres and 27.91% of the farmers in more than 10 acres of land. Majority of the curry leaf farmers (93.03%) used pesticide mixtures rather than applying single pesticide at a time, basically to save time, labour, money and to combat two or more pests with single spray. About 53.48% of farmers applied pesticides at 2 days interval followed by 34.89% of the farmers at 4 days interval and about 11.63% of the farmers sprayed at weekly intervals. Only 27.91% of farmers thought that the quantity of pesticides used at their farm is adequate, 90.69 % of farmers had perception that pesticides are helpful in getting good returns. 83.72% of farmers felt that crop change is the only way to control sucking pests which damages whole crop. About 4.65% of the curry leaf farmers opined that integrated pest management practices are alternative to pesticides and only 11.63% of farmers felt natural control as an alternative to pesticides. About 65.12% of farmers had perception that high pesticide dose will give higher yields. However, in general, Curry leaf farmers preferred to contact pesticide dealers (100%) and were not interested to contact either agricultural officer or a scientist. Farmers were aware of endosulfan ban (93.04%), in contrast only 65.12 per cent of farmers knew about the ban of monocrotophos on vegetables. Very few farmers knew about pesticide residues and decontamination by washing. Extension educational interventions are necessary to produce fresh curry leaf free from pesticide residues.

**Keywords:** *Murraya koeinigii*, leaf roller, Curry leaf, Psyllids, endosulfan, decontamination Tetranychid mite

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### I. Introduction

Curry leaf [*Murraya koeinigii* (L.) Sprengel] belonging to family Rutaceae, is a native of Sri Lanka. It is also seen in Burma, Huawei, South China and Indo-China and widely distributed in dry regions. In India, it is widely used in Kerala and Andhrapradesh and cultivated in south Indian states viz. Tamil Nadu, Kerala and Andhra Pradesh. It is a major ingredient in Indian cuisine, due to its aroma which is due to the presence of volatile oils. Due to high demand in Ayurveda medicinal use and culinary purpose, the commercial cultivation of curry leaf was started in some parts of southern states in India. Exports of curry leaf from India contained insecticide residues above maximum residue limits, which can be hazardous to consumer health and caused rejection of the commodity at point of entry. It is important to study current insecticide usage patterns in major curry leaf growing areas. Farmers feel it necessary to use larger quantities of insecticides causing greater than accepted levels of residues on the products. In Andhra Pradesh and Telangana curry leaf cultivation as a commercial crop is mostly confined to areas in Guntur, Krishna, Nellore, Medak and Nizamabad districts. Since it was hitherto grown in back yards, near the farm houses and cattle sheds and also due to the fact that not much damage is caused by pests and diseases the usage of pesticides was almost negligible. However, due to the increased crop area and changing scenario of weather, many pests and diseases are noticed, infesting the crop significantly both in quality & quantity. There is little known information on pesticide use in curry leaf, but it was determined that the chemicals used were potent and potentially dangerous if used incorrectly. Tara and Monika (2010) recorded 12 insect pests in 10 families of five insect orders infesting curry leaf plants in districts Jammu, Kathua, Udhampur, and Samba of Jammu region. *Psorossticha zizyphi* Stainton and *Diaphorina communi* Kuwayama (Homoptera) are major pests causing extensive damage. (Devaki et al, 2012) The major insect pests noticed in this crop are citrus butterfly, psyllids, scales, mealy

bugs and the fungal pathogen causing leaf spots causing crop losses both in terms of quality and quantity in curry leaf. This has resulted in farmers taking up pesticide sprays with an intention to obtain remunerative price and increased yield thus spoiling the quality of the leaves (Ramakrishnan et al 2015). Thus lead to the Pesticide residue on foliage, an important export commodity from India, rich in vitamin A and calcium (Khan et al., 1997). The plant has been identified as one of five vegetables with export potential. Fresh leaves are mainly exported to Persian Gulf and European nations. However, exported products can be contaminated with high residual concentrations of the insecticides resulting in rejection of the commodity (Mutwakil et al.,2009; Pinyupa et al.,2009). There are currently no insecticide recommendations for curry leaf and hence no threshold levels. Producers use pesticides that are designed to control the insect even if there are no recommendations for the crop. Pesticides are applied irrespective of whether the pest is present or not. To promote appropriate use of insecticides, it is critical to understand their current use in major curry leaf growing areas. There have been no published reports regarding insecticide use patterns in curry leaf. Hence, a survey was taken up to explore insecticide use patterns among curry leaf farmers.

## II. Materials and methods

**Survey on pesticide usage on Curry leaf** was carried out at farmer fields of 6 villages of Mangalagiri mandal, Guntur district of Andhra Pradesh based on the considerable area under Curry Leaf cultivation. A questionnaire was prepared to collect the data scientifically for statistical analysis on various parameters such as type of pesticides used at different crop growth stages, target pests and commonly occurring pests, waiting period followed for harvesting after application of pesticides and other socio economic aspects. Details of locations for field study is presented in Table -1.

**Table 1.** Details of locations of survey conducted in curry leaf growing areas of Guntur district

SI.No	Mandal	Village	Sample farmers
1	Mangalagiri	Gudimeda	3
		Ippatam	8
		Pedavadlapudi	11
		Revendrapadu	5
		Nutakki	9
		Tummapudi	7
Total			43

These investigations were undertaken to study Curry leaf farmers perception and demand for pesticide usage, management and their health effects on farmers. Formal and informal interviews were used to establish the relation between education level of farmers and safety measures adopted by them for pesticide usage at different crop growth stages, dose of pesticides, target pests and commonly occurring pests, waiting period followed for harvesting after application of pesticides and other socio economic aspects etc.

## III. Results and discussion

### General characteristics of farmers:

#### Age of the farmers

Around 16.28% of the farmers were in the age group of >50 years followed by 40-50 years (55.81%), 30-40 years (16.28%) and 20-30 years (11.63%). The analysis of education level of respondents showed that 2.32 % of respondents had college education; 13.96% farmers studied upto high school; 2.32% farmers had secondary education; 67.44% farmers with primary school education and 13.96% farmers were illiterates. About 88.37% of the farmers belonged to nuclear family and 11.62% of farmers belonged to joint family.(Table-2)

#### General information on curry leaf cultivation

**Age of the crop:** More than 11.63% of crops were 1 year old, 39.53 % of the crops were 2 to 5 years old, 16.28 % of the crops were of 5-10 years and 32.56 % were above 10 years old. Farmers usually had good awareness regarding selection of the seed and all the cultivation practices etc. 18.60% farmers were found cultivating curry leaf crop in less than 1 acre of land, 32.56% in 2-5 acres, 20.93% in 5-10 acres and 27.91% of the farmers in more than 10 acres of land. Some farmers were cultivating curry leaf in 30 to 40 acres of land since last 30 years. About 11.63% of the curry leaf farmers were aware of recommended pesticides against different pests and about 9.30% of respondents were aware of pesticide classification based on toxicity. It is observed that due to less literacy level of curry leaf farmers, only few were keen in knowing pesticide recommendations and large number of farmers were using pesticides without knowing recommendations. Majority of farmers are illiterates and literate's negligence led to application of pesticide without proper recommendation. Most of the farmers were unaware of pesticide

classification based on toxicity. Both these issues might be attributed to literacy level, insufficient extension activities and also negligence of farmers.(Table-3)

**Following safe methods while storing / mixing / spraying pesticides**

About 18.6% of farmers followed safe methods while storing or mixing or spraying pesticides. About 25.58 % of farmers measured chemical by bottle cap and 74.42% farmers measured approximately. About 11.63% of farmers mixed chemical with bare hands and 88.37 % mixed with stick. Majority of the farmers did not follow safe methods while storing or mixing or spraying pesticides, and it might be attributed to non availability of protective coverings and lack of awareness of pesticide effect on health. More than half of the respondents measured chemicals approximately as most of them were unaware of recommendations. The farmers, who were concerned about pesticide ingestion along with the food, mixed chemical with stick and not with hands, but few farmers who were careless about ill effects of pesticides, mixed pesticides with bare hands(Table-4)

**Pesticide effect on health of spray men and first aid followed**

Most of the respondents observed pesticide effect on health of spray men during spray. Most common health problems observed during spray in curry leaf fields include skin irritation (20.93%), cough (11.63%), eye irritation (20.93%), bad odour (37.21%) and head ache (9.30%).To combat these effects, majority of farmers used first aid methods like induced vomiting if pesticide is swallowed (9.30%), washing the affected area with water (20.93%) and washing the affected area with soap water (69.77%). All the farmers experienced some or the other problems, due to improper protective coverings, eating or smoking during pesticide application and not having proper bath after pesticide application. Farmers usually followed simple first aid practices which were helpful to victim until he was taken to hospital.

**Awareness on banned insecticides** Majority of the famers had good awareness of ban of endosulfan in agriculture (93.04%), in contrast only 65.12% of famers were aware that monocrotophos is banned for use on vegetables. The fact set of the farmers were aware about endosulfan ban in agriculture, might be due to kasargod incident which became global. 34.88% of the farmers were unaware of ban of monocrotophos in vegetables and this might be due to insufficient extension activities. (Table-4)

**Contact person for pesticide recommendations:** Curry leaf farmers preferred to contact pesticide dealers (100%) and were not interested to contact either agricultural officer or a scientist .All the farmers contacted pesticide dealers because farmers feel that dealers are having more experience in recommending pesticides and most often they neglect to contact agricultural officers and scientists as they have to travel some distance to contact them and have less rapport with these officials when compared to pesticide dealers.

**Pesticide mixtures and frequency of pesticide application:** Majority of the curry leaf farmers (93.03%) used pesticide mixtures rather than applying single pesticide at a time, basically to save time, labour, money and to combat two or more pests with single spray. About 53.48% of farmers applied pesticides at 2 days interval followed by 34.89% of the farmers at 4 days interval and about 11.63% of the farmers sprayed at weekly intervals. The fact that the curry leaf farmers applied pesticides at 2-4 days interval shows that farmers are more keen about the crop health.

**Awareness on pesticide residues:** Only 65.12% of curry leaf famers were aware that pesticide residues are found in vegetables and only 23.25 % of curry leaf farmers knew that pesticide residues in food enter into body and accumulate. Not even a single farmer was aware that for each pesticide, pre-harvest interval is recommended. Common waiting period of one day (79.07%) was followed by most of the curry leaf farmers and 20.93 % followed 2 days PHI (Post Harvest Interval). About 46.51% of the curry leaf farmers knew that pesticide residues in the food cause cancer, 30.24% of the farmers know that residues in the food causes other health effects and about 23.25% of farmers responded that they did not hear any kind of bad effects due to pesticide residues. Majority of curry leaf farmers were unaware of pesticides residues, their bad effects, pre harvest intervals and this might be attributed to literacy level of the farmers and insufficient extension activities.( Table-4A)

**Awareness of decontamination methods:** Majority (76.75%) of curry leaf farmers were aware of decontamination with normal water. Washing curry leaf before sending to the market was done by all the farmers for the removal of pesticides and to keep the leaves fresh during transportation. About 23.25% of the farmers also knew that salt water washing helps to remove pesticide residues. Majority of the farmers were unaware of various decontamination methods, but as a regular kitchen practice they wash curry leaf with tap water along with the other vegetables.

**Perception of farmers about pesticides and alternative methods of pest control:**

Among the curry leaf farmers only 27.91% of farmers thought that the quantity of pesticides used at their farm is adequate, and about 90.69 % of farmers had perception that pesticides are helpful in getting good returns. About 83.72% of farmers felt that crop change is the only way to control sucking pests which damages whole crop. About 4.65% of the curry leaf farmers opined that integrated pest management practices are alternative to pesticides and

only 11.63% of farmers felt natural control as an alternative to pesticides. About 65.12% of farmers had perception that high pesticide dose will give higher yields. Majority of the farmers thought that pesticides are helpful in getting good returns and very few states that integrated pest management practices and natural control measures are alternative to pesticides. This might be due to non-availability of natural pest control /management components, slow knock down of pests when compared to chemical pesticides and lower yields in initial years in case of natural control.

#### **Use of empty pesticide bottles and their disposal**

It was observed that majority of the farmers (30.24%) simply throw empty bottles in trash and few farmers (69.76%) also opined that they sell empty bottles. Proper disposal of empty pesticide bottles without using them for house or farm purpose is essential in order to avoid health hazards due to pesticides. Curry leaf farmers were not using pesticide bottles for house or farm purposes as they were aware of bad effects of pesticides. Disposal of these empty pesticides bottles was not carried out in a satisfactory way, as majority of the farmers were simply selling the bottles.

**Information on occurrence of insect pests** Curry leaf farmers feel that the major destruction of the crop is due to the Two spotted mites (*Tetranychus spp.*) followed by Scales (*Coccoidea spp.*), Aphids(*Toxoptera aurantii*), Citrus leaf miner (*Phyllocnistis citrella*) leaf roller, Citrus mealy bugs(*Planococcus citri*), Asian Citrus Psyllids (*Diaphorina citri*), Leaf eating caterpillar (*Spodoptera litura*), White fly (*Aleurodicus disperses*) and Citrus butterfly (*Papilio polytes*) in the range of 100, 97.66, 97.66, 93.02, 86.04, 81.39, 55.81, 46.51, and 23.25%, respectively. The farmers are slowly shifting to other crops due to more pest infestation and due to increase in resistance of pests to different pesticides.(Table-5)

#### **Types of pesticides used by curry leaf growers**

Major pesticides used by the curry leaf farmers are Imidacloprid 17.8% SL, Bifenthrin 10% EC, Profenophos 72% EC, Acephate 75% WP, Imidacloprid 70% WG, Profenophos 40%EC, Chlorpyrifos 20%, Triazophos 40%, Chlorantraniliprole, Acetamiprid 20%SP, Thiomethaxim 25% WG, Diafenthiuron 50% SC, Carbendazim 50% WP, Monocrotophos 36% SL, Bifenthrin 250% EC., Carbosulfan 25% SD and Spiromesifen 22.9% SC, where 100.00%, 97.67%, 97.67%, 95.34%, 95.34%, 93.02%, 90.69%, 81.39%, 81.39%, 69.76%, 53.48%, 51.16%, 41.18%, 39.53%, 30.23%, 27.90% and 13.95% farmers used above pesticides, respectively.( Table-6) Nagendra (2002) reported that only 5.8% of respondents contacted agricultural officers for suggestions on pest control, and in present study also only 15% of respondents contacted agricultural officers for suggestions which is in line with the work done by the Jana *et al.* (2012). The highly educated and also progressive farmers in their crop management usually contact specialist instead of local Agricultural Officer for suggestions. In present study growers had awareness of pesticide recommendations which are in conformity with the findings of Hosamani (2009), Nagendra (2002) and Jana *et al.* (2012) who reported 8.33%, 11.67% and 25% of respondents aware of pesticide recommendations, respectively. Usually, very few farmers will have knowledge on pesticide recommendations as per Act and GAPs of ICAR and SAUs, and are fully depend on neighbour farmer, local dealer or press / media reports, and in most cases pesticide dealer, except in case of progressive farmers and also vegetable growers for export purposes, who follow GAPs to avoid the pesticide residues. Awareness of pesticide classification based on toxicity indicated that very few farmers look at the colour code triangle on the pesticide bottle, as reported by Nagendra (2002) and Raghu (2015) who showed 14.17% and 27.50% of respondents had awareness of pesticide classification based on toxicity respectively. These reports depend on place, crop, purpose of product, use of the product, size of the pack etc. and it is necessary to educate the farmers on the toxicity codes of pesticides and care to be taken while handling the same at both farm and home level. In present study growers mixed pesticide with wooden stick and not with bare hands, and the results are in agreement with the findings of Patil *et al.* (2012) and Raghu(2015) who observed that 64.17% and 57% of respondents mixed pesticide with wooden stick and not with bare hands. Present investigation revealed growers have not used empty pesticide bottles for house/farm purpose, which is in line with the findings of Nagendra (2002) and Jana *et al.* (2012) who reported 85% and 53% of respondents have not used empty pesticide bottles for house/farm purpose, respectively. Further it was noticed that very few farmers try to sell the empty bottles to rag buyers, but no farmer is aware of the scientific disposal procedures for used packs / bottles. In the present study, most farmers felt that bad odour of pesticides is harming people, and noticed common health problems like skin irritation, cough, eye irritation, head ache, breathlessness in the spray men during and after spray operations at farm level. Similar observations were also noticed by farmers growing curry leaf in open fields, and few had head ache. These findings are in agreement with the findings of Nagendra (2002) who reported 97.43% and

51.67 % of skin irritation, respectively. Nagendra (2002) and Jana *et al.* (2012) recorded eye irritation (44.17% respondents), 35.83 and 22.00% had head ache, among the farmers engaged in spraying of pesticides and) . Jana *et al.* (2012) reported that 70% of the respondents experienced bad odour which is in line with the findings of present investigation.

**Table 2.**General characteristics of the farmers growing curry leaf

SI.No	Particulars	Frequency	Percentage
1.	<b>Age</b>		
	20-30	05	11.63
	30-40	07	16.28
	40-50	24	55.81
	>50	07	16.28
2.	<b>Educational status</b>		
	Illiterate	06	13.95
	Primary school	29	67.44
	Secondary school	01	2.32
	High school	06	13.96
	College	01	2.32
3.	<b>Type of family</b>		
	Nuclear	38	88.37
	Joint	5	11.62

Note: Figures in percentage are with respect to their respective frequency (n=43)

**Table 3..** General information regarding curry leaf cultivation

SI.No	Particulars	Frequency	Percentage
1	<b>Age of the crop</b>		
	1 year	5	11.63
	2-5 years	17	39.53
	5-10years	7	16.28
	>10 years	14	32.56
2	<b>Crop area</b>		
	< 1acre	8	18.60
	2-5 acres	14	32.56
	5-10 acres	9	20.93
	> 10 acres	12	27.91

**Table 4..** General awareness of farmers on pesticides and their use

SI.No	Particulars/comments	Frequency		Percentage	
		Yes	No	Yes	No
1	Are you aware about recommended pesticides against different pests	5	38	11.63	88.37
2	Are you aware about the pesticide classification based on toxicity	4	39	9.30	90.70
3	Do you follow safe methods while storing / mixing / spraying pesticides	8	35	18.60	81.40
4	Do you observe pesticide effect on health of spray men during spray	43	0	100.00	0.00
5	Are you aware that endosulfan is banned for use	40	3	93.04	6.97
6	Are you aware that Monocrotophos is banned for use on vegetables	28	15	65.11	34.88
7	Do you use pesticide mixtures	40	3	93.03	6.97
8	Are you aware that for each pesticide, pre-harvest interval is recommended	0	43	0.00	100.00
9	Are you aware that pesticide residues are found in vegetables	28	15	65.12	34.88
10	Do you know that pesticide residues in food enter into body and accumulate	10	13	23.25	76.75
11	Are you aware about pesticide decontamination method	30	13	69.77	30.23
12	Are you aware that food exports are rejected due to pesticide residues	5	38	11.63	88.37
13	Do you think the quantity of pesticides used as adequate	12	31	27.91	72.09
14	Do you think that pesticides are helpful in getting good returns	39	4	90.69	9.31
15	Do you think high pesticide dose gives higher yields	28	15	65.12	34.88
16	Use of empty bottles for house / farm purpose	0	43	-	100.0

**Table-4 A** General awareness of farmers on pesticides and their use

SI.No	Particulars/comments	Frequency	Percentage
17	<b>How do you measure the chemical</b>		
	Bottle cap	11	25.58
	Approximately	32	74.42
18	<b>How do you mix the chemical</b>		
	Bare hands	5	11.63
	Stick	38	88.37
19	<b>Most common health problem observed during spray</b>		
	Skin irritation	9	20.93
	Cough	5	11.63
	Breathlessness	0	0.00
	Eye irritation	9	20.93
	Bad odour	16	37.21
	Head ache	4	9.30
20	<b>Best first aid you follow</b>		
	Induce vomiting if swallowed	4	9.30
	Washing the affected area with water	9	20.93
	Washing the affected area with soap water	30	69.77
21	<b>Whom you contact, for pesticide recommendations</b>		
	Agricultural officer	0	0.00
	Dealer	43	100.00
	Scientist	0	0.00
22	<b>How frequently you apply the pesticides</b>		
	2 Days	23	53.48
	4 days	15	34.89
	Week	05	11.63
23	<b>Common waiting period you follow after pesticide spray</b>		
	1 Day	34	79.07
	2 Day	9	20.93
	4 Day	0	0.00
	Week	0	0.00
24	<b>What type of bad effects you heard due to pesticide residues in food</b>		
	Cancer	20	46.51
	Physical impairments	13	30.24
25	<b>Common method of decontamination followed</b>		
	Salt water wash	10	23.25
	Water wash	33	76.75
26	<b>Best alternative for pesticide use</b>		
	Crop change	43	100.00
	Natural control	0	0.00
	Integrated pest management	0	0.00
27	<b>What is the disposal method you follow for empty pesticide bottles</b>		
	Bury in soil	0	0.00
	Sell	30	69.76
	Throw in to trash	13	30.24

Note: Figures in percentage are with respect to their respective frequency (n=43)

**Table 5.** Information on occurrence of insect pests

SI. No	Insect pest	Scientific name	Frequ-ency	Percentage
1	Scales	Coccoidea spp.	42	97.67
2	Citrus butterfly	Papilio polytes	10	23.25
3	Aphids	Toxoptera aurantii	42	97.67
4	Citrus mealy bugs	Planococcus citri	37	86.04
5	Citrus leaf miner	Phyllocnistis citrella	40	93.02
6	Asian Citrus Psyllids	Diaphorina citri	35	81.39
7	Two spotted mites	Tetranychus spp.	43	100.00
8	White fly	Aleurodius indicus	20	46.51
9	Leaf eating caterpillar	( <i>Spodoptera litura</i> )	24	55.81

Note : n=43

**Table 6.** Types of pesticides used by curry leaf growers

Sl.NO	Chemical name	Trade name	Frequency	Percentage
1	Profenophos 40% EC	Carina	40	93.02
2	Triazophos 40%	Hostothion	35	81.39
3	Imidacloprid 70% WG	Admire	41	95.34
4	Acetamiprid 20% SP	Pride	30	69.76
5	Carbosulfan 25% SD	Marshall	12	27.90
6	Bifenthrin 10% EC	Marker	42	97.67
7	Acephate 75% WP	Orthene	41	95.34
8	Imidacloprid 17.8% SL	Confidor	43	100.00
9	Chlorpyrifos 20% & 50% EC	Chlorogaurd	39	90.69
10	Thiomethaxim 25% WG	Actara	23	53.48
11	Bifenthrin 250% EC	Tallstar	13	30.23
12	Monocrotophos 36% SL	Monostar	17	39.53
13	Spiromesifen 22.9% SC	Oberon	6	13.95
14	Chlorantraniliprole	Coragen	35	81.39
15	Profenophos 72% EC	Curacron	42	97.67
16	Diafenthiuron 50% SC	Polo	22	51.16
17	Carbendazim 50% WP	Bavistin	19	41.18

Note: Figures in percentage are with respect to their respective frequency (**n=43**)

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